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Title: Material Stream Strategy for Lithium and Inorganics (U)

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Material Stream Strategy for Lithium and Inorganics (U)

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Delivering science and technology
to protect our nation
and promote world stability

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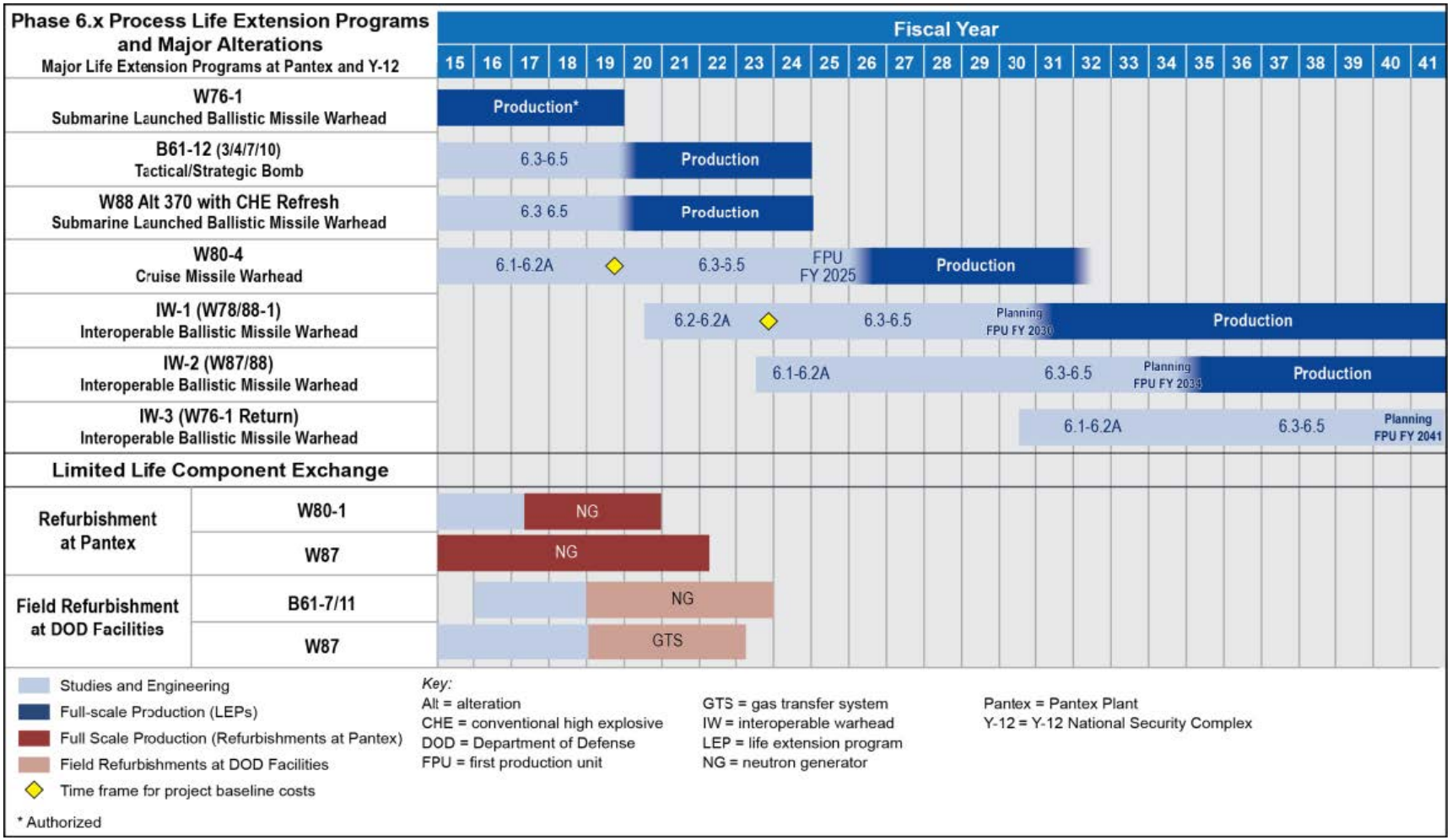
Design Agency Responsibilities

- **Manufacturing Support to meet Stockpile Stewardship goals** for maintaining the nuclear stockpile through experimental and predictive modeling capability.
- **Development and maintenance of Manufacturing Science expertise** to assess material specifications and performance boundaries, and their relationship to processing parameters.
- **Production Engineering Evaluations** with competence in design requirements, material specifications, and manufacturing controls.
- **Maintenance and enhancement of Aging Science expertise** to support Stockpile Stewardship predictive science capability.

"A special concern is the effect of materials and manufacturing changes on the performance of components that can no longer be tested." --- predictive capability and SS tools are needed to support lifetime assessments, lifetime extensions, and re-use options.
FY16 SSMP Annex

Stockpile Life Extension Program



LEP and SS work will require Lithium and Inorganic Materials stream capabilities for at least the next 25 years.

UNCLASSIFIED

Capability Gaps Impacting Stockpile Stewardship and Management Missions

- Material synthesis, processing, and characterization capabilities that can meet Stockpile Stewardship timelines and avoid priority conflicts with production.
- Manufacturing capability to produce prototype and test hardware that meets WR-like quality requirements.
- Sustainable workforce with knowledgeable, skilled, and proactive personnel dedicated to advancing material capability and competence.

Current manufacturing capability is not capable of meeting the goals of **increased experimental productivity** or supporting **detailed examination of replacement material options**.

Sigma Strategic Goals

- Direct partnership with the Production Agency to gain mutual understanding, trust, and shared fate in long-term interests.
- LANL facilities that successfully manage the known risk to ES&H for hazardous operations and information control according to security requirements.
- Processing equipment that is modern, maintained, and capable of meeting the stringent WR-like quality requirements.
- Knowledgeable, skilled, and proactive workforce that not only meets program expectations but advances competency and capability through Manufacturing Science, for purpose of informing Stockpile Stewardship and Production missions.

Sigma strives to become the resource of choice and trusted partner for Stockpile Stewardship and Management decisions and an integral component of the correct investment strategy for future capability.

Conclusions

- The Stockpile Stewardship and Management mission RISK is increasing due to (1) Stockpile age and (2) Atrophy of manufacturing capabilities (both personnel and equipment).
  - Production capacity demands are increasing.
  - Stockpile Stewardship experimentation to meet the goals of predictive capability needs significantly increased pace.
- Long-term investment in the Lithium and Inorganic Material Stream Capability is needed to meet current and future Stockpile Stewardship demands.
- A strategic partnership between Production and Design Agencies needs to be re-invigorated to mitigate emerging risk and successfully meet SSMP goals.

Sigma Division at LANL has historically served the SSMP mission and will be a strong contributor to future SSMP successes.

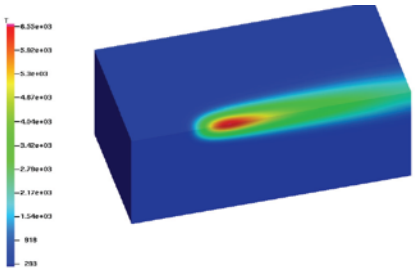
BACK UP SLIDES

Certification – Manufacturing Science

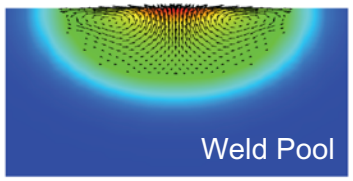
Process Modeling ⟷ **Microstructure Modeling** ⟷ **Properties Modeling** ⟷ **Performance Modeling**

TRUCHAS code

3D multiphysics microstructure-aware solidification capability

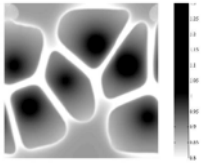


Moving heat source



Direct numerical simulation of grain growth

Initial grain distribution (Nucleation site)



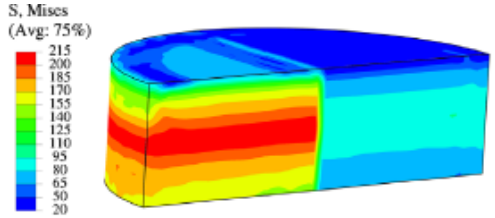
Final grain shape and composition

Polycrystal models to determine elastic/plastic/ damage properties

Polycrystal and grain boundary properties

AM specific interface properties

Thermal - mechanical models to predict elastic/plastic/ damage and failure processes



Mesoscale to macroscale prediction of performance

Liquid/solid phase change **Solid/solid phase transformation**

LANL and LLNL are the only resources that have fully engaged the Manufacturing Science to Predictive IDC for Certification Grand Challenge

Responsive Infrastructure – Experiments

- The NNSA goal to increase operational efficiencies will enable:
  - Increased rate of hydrodynamic experiments (10/yr at DARHT)
  - Increased rate of subcritical experiments in Nevada
  - Increased experimental capability development at extreme conditions (e.g. NIF)

- A continuous cycle of manufacturing technology development and maturation activities ensures that modern, well-understood, and sustainable manufacturing capabilities are ready for future stockpile sustainment needs.

With reduced funding and intermittent operations the NSE has not met the demands of the current experimental program causing significant delays and missed opportunities.